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Volume 45 **MAY 1954** **Number 5**

The Poliomyelitis Epidemic in Winnipeg, 1953
R. G. CADHAM

Pathogenic Staphylococcal Infections
M. SAINT-MARTIN, S. SONNEA
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Oil Partition for Collection of Tubercle Bacilli
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Tuberculosis in Ontario
G. C. BRINK

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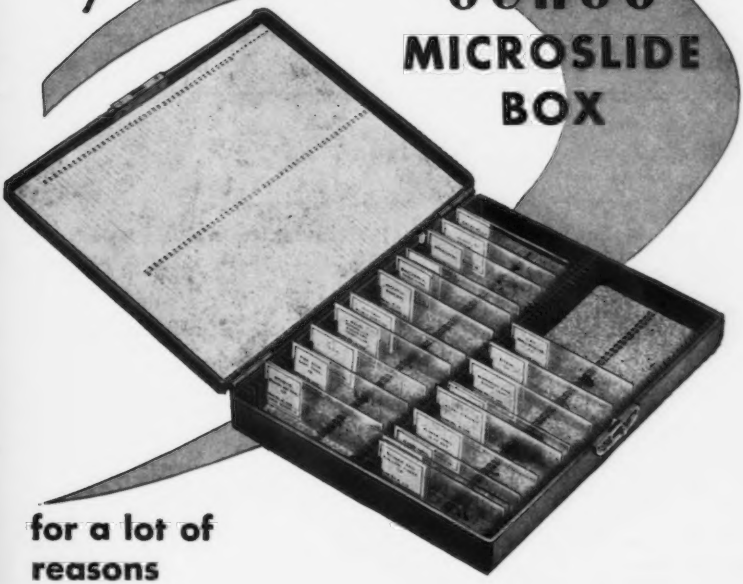

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Canadian Journal of
PUBLIC HEALTH

VOLUME 45 TORONTO, MAY 1954 NUMBER 5

The Poliomyelitis Epidemic in Winnipeg, 1953

EPIDEMIOLOGICAL STUDY, INCLUDING THE USE OF GAMMA GLOBULIN

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Winnipeg, Manitoba

DURING the summer months of 1953 the City of Winnipeg (population 243,000) experienced the second largest case rate of poliomyelitis ever to occur in North America in an urban population of over 200,000. A total of 763 cases was reported. The case rate was 318 per 100,000 population. Type I virus was identified in stool specimens from hospital patients. The only previous epidemic in a large urban centre in which this case rate was exceeded was in Newark, New Jersey, in 1916, with a case rate of 340 per 100,000 population. Other severe poliomyelitis epidemics with a high incidence of reported cases in American cities with populations in excess of 200,000 are as follows (1): Los Angeles (1934), 95; Providence (1935), 100; Buffalo (1944), 110; and Minneapolis (1946), 150.

In Table I are shown the number of reported cases and the case rate for epidemics of poliomyelitis which have occurred in Winnipeg. In the 1953

TABLE I

POLIOMYELITIS—WINNIPEG

Cases and Death Rates for Epidemic Years

Year	Cases	Case Rate Per 100,000 Population	Deaths	Case Fatality Rate
1928	279	138.	17	6.1
1936	107	48.	6	5.6
1941	264	117.	7	2.6
1947	156	67.	0	—
1952	131	55.	2	1.5
1953	763	318.	35	4.6

epidemic the number of cases was more than double those reported in any previous epidemic. As there had been an epidemic (131 cases) in 1952 within the city, it was estimated that 1953 would see comparatively few cases reported. A high incidence of poliomyelitis had not previously occurred in Winnipeg on two consecutive years. The number of cases following former epidemic years of 1928, 1936, 1941 and 1947 were 19, 54, 18 and 38, respectively.

Early in May, 1953, two children in the same household developed poliomyelitis with paralysis. No further recognized cases occurred until the last week of June, when 16 cases were reported from scattered areas throughout the city. No contact, direct or indirect, could be traced to any of these cases, with the exception of the first two cases, which occurred in the same family household. This lack of demonstrable contact is in contrast to that which occurred later in the epidemic, when cases were frequently reported from a number of homes in close proximity with each other, suggesting contact or a common source of infection. This localization of cases on 17 streets accounted for 141 cases. As there are 617 streets in Winnipeg, the occurrence of approximately one-fifth of the reported cases on 17 streets provokes some speculation.

The sudden appearance of 16 cases in the last week of June, a greater number than had been reported for June in any previous epidemic year, was a disturbing indication that the city was to experience a major epidemic. Due to the variation in the number of cases reported in inter-epidemic years, it was not possible to predict the probable case rate for the ensuing weeks by any of the methods outlined by some statisticians.

Of the five years in which Winnipeg had experienced an epidemic of poliomyelitis (1928, 1936, 1941, 1947 and 1952), only in 1928 and 1941 had cases occurred as early as late June and these epidemics had reached their peaks in the 12th week and the 9th week respectively. It was observed that in both these epidemics the number of cases reported in the peak week was approximately six times the number reported in the first week. If the same case rate pattern was to recur in 1953, it would indicate, at the time, that there would be a steady increase in the number of weekly cases reported until the 9th to the 12th week of the epidemic had been reached. It would also suggest that at the peak week of the epidemic approximately 96 new cases would occur, or six times the number of cases reported in the first week. These deductions, although we hoped they would not eventuate, became fact. From the 6th to the 9th week the weekly reported incidence ranged from 93 to 84 cases.

In Chart 1 is shown the number of cases reported by weeks during the summer months for some of the epidemics which Winnipeg has experienced. The 1953 epidemic might be termed explosive, as the weekly case incidence rose to a maximum of 93 within 6 weeks (the last week in July) and a relatively high number of cases continued to be reported until the end of September.

From Table II it appears that during the epidemic there was:

(*a*) A higher incidence of the disease in males from 0–19 years than in females.

(*b*) In the age group 20 years and over, a slightly higher incidence of the disease in females.

TABLE II

POLIOMYELITIS IN WINNIPEG—1953

Cases by Sex in Five-Year Age Groups—With and Without Paralysis

Age Group	Total	Per cent of Total	Male			Female		
			With Paralysis	Without Paralysis	Total	With Paralysis	Without Paralysis	Total
0–4	208	27.2	73	41	114	63	31	94
5–9	201	26.4	61	51	112	51	38	89
10–14	71	9.3	18	20	38	17	16	33
15–19	42	5.5	12	7	19	12	11	23
20–24	71	9.3	12	14	26	28	17	45
25–29	62	8.1	19	8	27	22	13	35
30–34	50	6.6	16	11	27	11	12	23
35–39	33	4.3	14	8	22	5	6	11
40 and over	25	3.3	12	1	13	4	8	12
TOTAL	763	100.0	237	161	398	213	152	365

(*c*) Except for the male age group 40 years and over, a comparatively constant ratio of paralytic to non-paralytic cases, for both sexes.

(*d*) A comparatively small number of cases among the 15–19 year age group (5.5%).

The latter observation suggested that this age group (15–19 years) had developed an immunity during the 1941 epidemic. The number of cases for

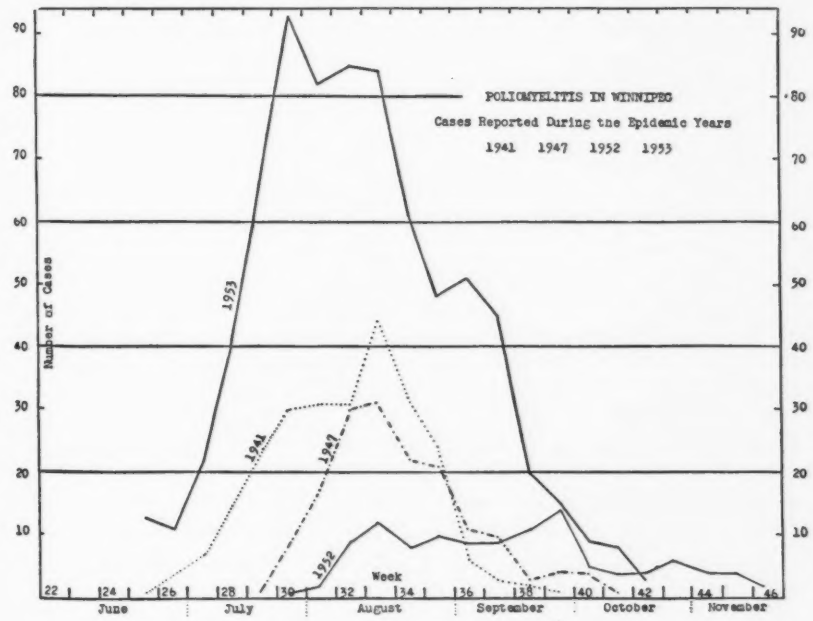


CHART 1

each year of age from 1 year to 24 years which occurred during 1953 is given below. The possible immunizing effect of the 1941 epidemic is indicated in the marked limitation in the number of cases which occurred in individuals who were from 14 to 18 years of age inclusive; this group was 1–5 years of age in 1941.

Year of Age	No. Cases	Year of Age	No. Cases	Year of Age	No. Cases
−1	20	8	27	16	7
1	34	9	31	17	6
2	34	10	18	18	9
3	66	11	23	19	16
4	54	12	15	20	9
5	53	13	11	21	14
6	47	14	4	22	19
7	43	15	4	23	12

The average number of cases for ages 14–18 inclusive was 5 as compared with 29 for all other ages up to age 24.

Paralysis

Fifty-nine per cent of patients had some degree of paralysis at the time the case was reported. No significant variation occurred in the percentage of cases with paralysis among any age group. The highest incidence of paralysis occurred in the age group 25–29 years, in which group 66% of the patients suffered paralysis. The lowest incidence was in the age group 10–14 years, with 49% of cases being paralytic. Due to the restriction on providing gamma globulin only to household contacts of paralytic cases, the procedure followed was to require that the existence of paralysis in any patient be confirmed at the King George Municipal Hospital or in the home by an experienced neurologist or pediatrician employed for this purpose by the City Health Department.

The status of 450 paralytic cases approximately three months after the onset of paralysis was as follows: slight paralysis, 111 (24.6%); moderate paralysis, 110 (24.4%); marked paralysis, 54 (12.0%); recovery—no paralysis, 121 (27.0%); deceased, 35 (7.8%); incomplete records, 19 (4.2%).

Age Incidence—School Opening

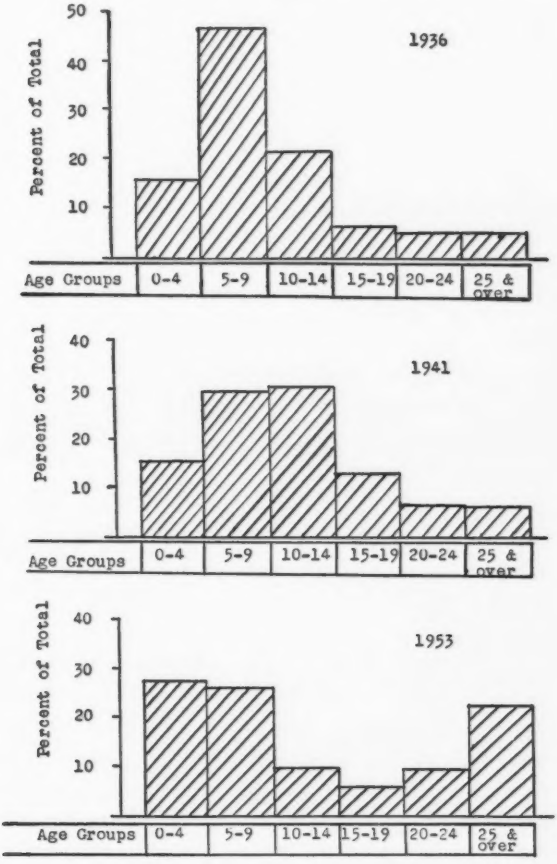
Chart 2 compares the percentage of total cases by 5-year age groups for the years 1936, 1941 and 1953. It will be seen that, compared to the 1936 epidemic, there has been a shift in the incidence of the disease at various age levels, with more cases appearing among the older age groups. There has been a noticeable reduction in the percentage of infection in the 0–14 age groups, from 91% of the total cases in 1936 to 62.9% of the total cases in 1953.

Chart 3 compares the incidence of infection by 5-year age groups for each 100 consecutive cases up to the 7th consecutive group of 100 reported cases (600th to 700th). As the epidemic progressed and until the 7th group of 100 cases was reached, there was a steady decline in the number of cases reported in the age groups 0–4 and 5–9; little change occurred in the incidence of infection among the age group 10–14; and there was an increase in the number of cases reported in the older age groups.

However, the 7th consecutive group of 100 cases did not follow the above pattern. In this group there was an increase in the percentage of total cases

CHART 2 - POLIOMYELITIS IN WINNIPEG

Percentage Distribution of Cases by Five-Year Age Groups for the Epidemic Years 1936, 1941 and 1953.

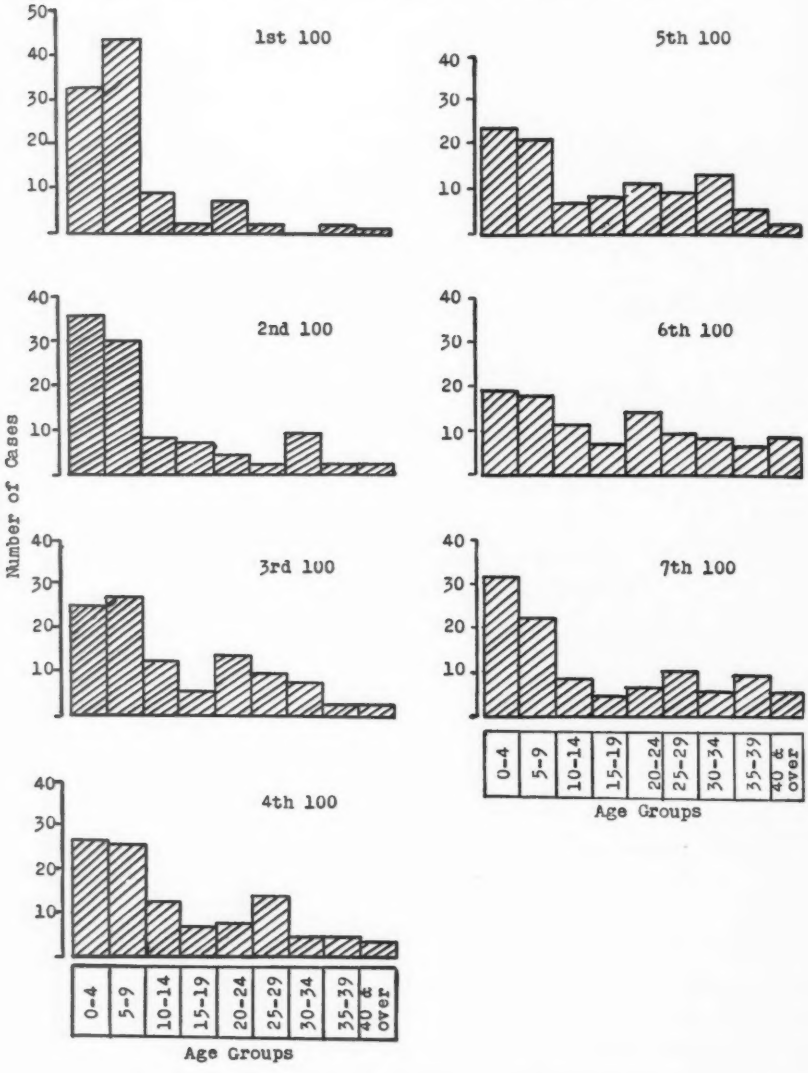


in children, particularly in the 0–4 age group. The time of reporting the 600th to 700th group of cases occurred in a period from September 9th to September 28th. Schools opened on September 14th. This sequence of events raised the question of a possible relationship between this increase of infection in preschool children and the opening of schools.

There was a steady decline in the percentage of total cases reported in the 0–4 age group from the beginning of the epidemic until the two-week period from August 31st to September 13th. At that time there was a rise in the percentage of total cases in the 0–4 year age group. Had schools opened on September 1st, it is quite likely that this would have been suspect as responsible for the rise in percentage of cases in the preschool age group. However, school opening was delayed until September 14th, and as the rise occurred before

CHART 3 - POLIOMYELITIS IN WINNIPEG, 1953

Age Distribution of Each Consecutive 100 Cases by Five-Year Age Groups



this date, the evidence suggests that the opening of schools was not responsible for the increase in incidence in the preschool age group. The return of thousands of children to the city at the end of the summer holidays in the last few days of August possibly was a factor in the increase in percentage of cases in the 0–4 year age group during the period August 13th to September 13th. A second rise in the per cent of total cases in this age group occurred in the period from

September 17th to October 11th, which corresponds to a period of two weeks to four weeks after the opening of schools. However, the significance of this rise is difficult to assess, since but a small number of cases was involved. In the school age group a slight rise in the per cent of total cases occurred in the two-week period immediately following the opening of schools—September 13th to September 27th. Again the number of cases involved is so limited that no definite conclusion is justified.

Mortality

In Table III is shown the number of cases by sex and 10-year age groups, the percentage of each age group with paralysis, the number of deaths and the death rate per 100 cases. It will be seen that although there is no marked difference in the percentage of paralysis in each age group, there is considerable variation in death rate between these age groups, from a low rate of 1.2 in the

TABLE III

Poliomyelitis in Winnipeg—1953

Number of Cases, Per cent with Paralysis, and Deaths by Sex, in Ten-Year Age groups

Age Group	Number of Cases	Per cent Paralysis	Deaths	Sex		Death Rate Per 100 Cases
				Male	Female	
0–9	409	58.0	5	5	–	1.2
10–19	113	52.0	6	2	4	5.3
20–29	133	60.9	10	4	6	7.5
30–39	83	55.5	7	5	2	8.4
40 and over	25	64.0	7	7	–	28.0
Total	763	59.0	35	23	12	4.6

0–9 age group to a high of 28 in the age group over 40. No explanation for this high death rate in the age group over 40 is forthcoming. Another unexplained feature is that all deaths in the age groups 0–9 and over 40 were in males.

Secondary Cases

In epidemics reported from other areas of the continent, the occurrence of secondary or multiple cases in one household had frequently been in the neighbourhood of 5%. Prior to 1953 the occurrence of known secondary cases in Winnipeg during the epidemic years had been relatively rare. However, in 1953 there were 45 instances where more than one case occurred in the same home—an incidence of 6%. In 43 homes 2 cases occurred, in one home 3 cases, and in one home 4 cases, a total of 48 cases. Perhaps the term "secondary case" should not be applied to patients who developed symptoms in the first day or two subsequent to the primary case. It would seem more probable that these patients were exposed at the same time as the primary cases and received their infection from the same source.

The time interval between the onset of symptoms in the primary patient and in the secondary patient in a household was as follows: 1st to 7th day,

27 cases (56.4%); 8th to 14th day, 14 cases (29.0%); 14th to 35th day, 7 cases (14.6%).

In a household where a primary case was paralytic, 10 non-paralytic secondary cases and 10 paralytic secondary cases occurred. Where the first case was non-paralytic, 20 non-paralytic secondary cases and 6 paralytic secondary cases occurred.

Gamma Globulin

When it became evident that Winnipeg was in the throes of an epidemic, the Federal Gamma Globulin Advisory Committee made gamma globulin available, with the recommendation that it be given only to household contacts of paralytic cases between the ages of 6 months and 11 years. Consequently, on July 9, 1953, a clinic was established in the Princess Elizabeth Municipal Hospital for the purpose of inoculating those individuals who were eligible for gamma globulin. Eligibility was determined by a medical specialist, who confirmed a physician's report of the existence of paralysis, and also by information obtained by health inspectors. The latter at once visited each home where paralytic poliomyelitis had been confirmed and issued a certificate for each contact, resident in the home, between 6 months and 11 years of age. These individuals could then present themselves, with their certificate, at the clinic in the Princess Elizabeth Municipal Hospital and receive gamma globulin. Due to the limitation of the amount of gamma globulin available, the maximum dose was 10 c.c. and the minimum dose 5 c.c., with proportionate doses between 5 and 10 c.c. dependent upon body weight in the ratio of 0.14 c.c. per pound of body weight.

Due to the number of cases which were occurring in the ages from 12 years to 30 years, permission was later obtained (July 23rd) from the Advisory Committee to extend the age limit of those eligible for gamma globulin to 30 years of age. Pregnant women who were household contacts to either paralytic or non-paralytic cases were eligible for gamma globulin once it became available.

Thirteen cases of poliomyelitis, including 3 cases with paralysis, developed in a total of 1,403 persons who received gamma globulin. Eight of these cases were admitted to the King George Municipal Hospital. In only one of these persons who had received gamma globulin did the disease develop more than 7 days after gamma globulin was received.

The interval of time between receiving gamma globulin and the onset of illness was:

	Paralytic	Non-Paralytic
1 received gamma globulin on same day as onset of illness		1
2 received gamma globulin one day before onset of illness		2
3 received gamma globulin two days before onset of illness		3
3 received gamma globulin three days before onset of illness	1	2
1 received gamma globulin four days before onset of illness	1	
1 received gamma globulin five days before onset of illness		1
1 received gamma globulin six days before onset of illness		1
1 received gamma globulin twenty-five days before onset of illness*	1	
Total	3	10

*This case was a 19-year-old girl who was a household contact to a fatal case of bulbar poliomyelitis. This patient developed the disease, with paralysis in both legs, 25 days after receiving gamma globulin.

In an attempt to assess the value of gamma globulin in the prevention of poliomyelitis, a control group of 502 household contacts to paralytic cases who did not receive gamma globulin was analyzed for the incidence of poliomyelitis. These 502 people were not eligible for gamma globulin because they were contacts before gamma globulin was available or were over or under the age limits recommended by the Federal Gamma Globulin Advisory Committee, or because the interval of time between the onset of disease in the household case and the development of paralysis was more than 7 days; at no time during the epidemic was the latter group of contacts eligible for gamma globulin. The large majority of these contacts were over 30 years of age and hence considered likely to have some immunity.

Thirteen cases of poliomyelitis occurred among this group of 502 control contacts; 10 of these patients had paralysis. The interval of time between known exposure and the onset of illness in those contacts who did not receive gamma globulin was:

	Paralytic	Non-Paralytic
1 with onset on same day as known exposure	1	
1 with onset two days after known exposure	1	
1 with onset four days after known exposure	1	
1 with onset five days after known exposure		1
1 with onset six days after known exposure	1	
3 with onset seven days after known exposure	2	1
1 with onset eight days after known exposure		1
1 with onset eleven days after known exposure	1	
1 with onset thirteen days after known exposure	1	
1 with onset fourteen days after known exposure	1	
1 with onset twenty days after known exposure	1	
	10	3
TOTAL	13	

Table IV compares the incidence of disease among the household contacts to that among paralytic cases who did and who did not receive gamma globulin. It will be seen that the incidence of infection was considerably lower among those who received gamma globulin. The case rate per 1,000 household con-

TABLE IV

POLIOMYELITIS AMONG HOUSEHOLD CONTACTS WHO DID AND WHO DID NOT RECEIVE GAMMA GLOBULIN, WINNIPEG, 1953

Contacts to Paralytic and Non-Paralytic Polio	Number of Contacts	Number Developing Polio	Rate Per 1,000 Contacts	Paralytic		Non-Paralytic	
				Number	Rate Per 1,000 Contacts	Number	Rate Per 1,000 Contacts
Contacts to paralytic polio:							
(1) receiving gamma globulin	1,403	13	9.2	3	2.1	10	7.0
(2) not receiving gamma globulin	502	13	25.9	10	19.9	3	6.1
Contacts to non-paralytic polio:							
(1) not receiving gamma globulin	1,103	22	19.9	6	5.4	16	14.5

tacts who received gamma globulin and who developed paralytic poliomyelitis was 2.1, compared to 19.2 for those contacts to paralytic cases who did not receive gamma globulin. For further comparison it should be noted that among 1,103 contacts to non-paralytic poliomyelitis who were not eligible for gamma globulin at any time during the epidemic there occurred 22 cases of poliomyelitis—6 with paralysis and 16 with no paralysis. It is of interest to conjecture whether or not some of these cases would have been prevented had gamma globulin been available for this group of contacts.

Summary

In the summer months of 1953 Winnipeg experienced a severe epidemic of poliomyelitis (Type I virus), with a case rate of 318 per 100,000 population. Localization of cases in certain areas of the city was noted in the later stages of the epidemic. Fifty-nine per cent of the reported cases developed paralysis. The death rate was 4.6. There has been a shift in the incidence of disease among the various age groups, with a higher percentage of cases occurring among the older age groups. The incidence in the age groups suggests that in the epidemic of 1941 an immunity was developed in the children from 1–5 years of age. The incidence of more than one case in a household was 6%. The incidence of poliomyelitis among contacts who received gamma globulin was lower than among the contacts who did not receive gamma globulin.

ACKNOWLEDGMENT

The author wishes to express his appreciation to Dr. F. E. Whitworth, Research Statistician, Department of National Health and Welfare, Ottawa, and to Dr. Maxwell Bowman, Epidemiologist to the Manitoba Department of Health and Public Welfare.

REFERENCE

1. Personal communication from Halbert L. Dunn, M.D., Chief, National Office of Vital Statistics; Department of Health, Education and Welfare, Public Health Service, Washington, D.C.

Tuberculosis in Ontario

G. C. BRINK, M.D., D.P.H.
Director, Division of Tuberculosis Prevention
Department of Health for Ontario
Toronto

THOSE who are not familiar with the current status of the tuberculosis situation in Ontario might be inclined to believe that the disease is under control and even that it has ceased to be a significant problem. Table I will show that tuberculosis is still a major public health challenge.

Most of us are aware of the marked decline in the tuberculosis mortality rate during the last quarter century and more especially in the last seven years. This experience is shared in all countries to a greater or lesser extent. Improved living conditions have played their part, but all agencies and individuals giving their efforts towards the prevention of tuberculosis share

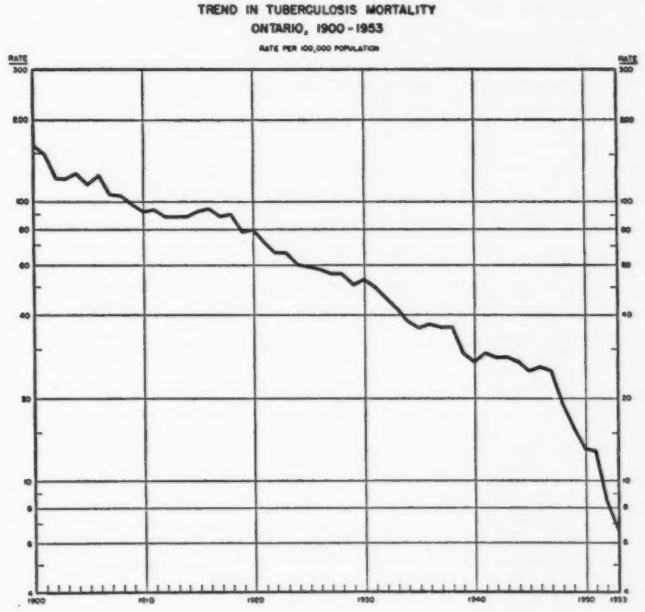


CHART 1

in the credit for the improvement that has taken place. The recent accelerated drop in mortality is likely related to the extensive use of the new antibiotics during the last few years. More successful surgery has been made possible by

Presented at a meeting of the Academy of Medicine, Toronto, on March 24, 1954.

TABLE I

NUMBER OF DEATHS AND MORTALITY RATES PER 100,000 POPULATION, ONTARIO, 1952

Infective Diseases	From		Tuberculosis	
	Number	Rate	Number	Rate
Typhoid, Paratyphoid	3	.06	398	8.4
Cerebrospinal Meningitis	18	.4		
Scarlet Fever (inc. late effects)	4	.09		
Erysipelas	2	.04		
Whooping Cough	13	.3		
Diphtheria (inc. late effects)	4	.09		
Syphilis	84	1.8		
Influenza	164	3.4		
Measles	17	.4		
Poliomyelitis and Polioencephalitis (inc. late effects)	49	1.1		
	358	7.5	398	8.4

these therapeutic agents. It is a fallacy to judge the effectiveness of the tuberculosis control program solely on the mortality rate, which has decreased 70% in the last decade. Of equal importance is information regarding the incidence and prevalence of the disease.

A distinction between incidence and prevalence should be appreciated. The incidence is based on the number of new cases developing in a given year. The prevalence is the total number of all types of living cases of tuberculosis, some of whom have been known for years. The estimated number of undiscovered cases should be added to the number of known cases.

The number of cases entering sanatorium for the first time can be compared from year to year and is a fairly good index for measuring the incidence of the disease. During the last ten years the number of new cases admitted to sanatorium annually shows no significant change. In view of an increase of 825,000, or 21.7%, in population over this period, one can deduce that there has been a decrease in incidence based on new admissions to sanatorium. The rate of first admissions per 100,000 population in 1943 was 54 as compared to 47 in 1952—a decrease of 12.9% (Table II). In this interval there has been an increase of 493, or 13.7%, sanatorium beds.

TABLE II

CLASSIFICATION OF ADMISSIONS TO SANATORIA

Year	First Admissions		Readmissions		Sanatoria Beds	
	Number	Rate*	Number	Rate*	Number	Rate*
1943	2,133	54	689	17	3,582	91
1944	2,145	54	703	18	3,640	92
1945	2,166	54	754	19	3,656	91
1946	2,176	53	782	19	3,642	89
1947	2,145	51	872	21	3,735	89
1948	2,300	54	849	20	3,941	92
1949	2,207	50	928	21	4,004	91
1950	2,262	50	938	21	4,055	91
1951	2,204	48	928	20	4,069	88
1952	2,228	47	919	19	4,075	86

*Rate per 100,000 population.

It is a fact that the percentage of reactors to tuberculin (indicating infection some time in the past) in all age groups has decreased. In 1923, of the high school students tuberculin tested, 58% were reactors and today the percentage has dropped to below 10% and in some localities to under 5%.

It seems reasonable to assume that, in view of the decrease in the percentage of individuals infected as shown by the tuberculin test, there must be fewer active cases spreading infection in the general population.

There appears to be a paradox in that fewer apparently healthy people had to be screened in community mass surveys in 1953 to find one active case of pulmonary tuberculosis than in any year since the inception of these surveys.

TABLE III

NUMBER OF PERSONS SCREENED TO FIND ONE ACTIVE CASE OF PULMONARY TUBERCULOSIS

1946	—	1,428
1947	—	1,668
1948	—	1,702
1949	—	1,487
1950	—	1,492
1951	—	1,805
1952	—	1,571
1953	—	1,222

One must, however, take into consideration the particular areas in which surveys are conducted in any one year. In highly industrialized areas the yield is greater than in the more rural areas. Another factor that requires study which might have a bearing on the results is the possibility that people who were not x-rayed in previous surveys are now co-operating to a greater degree than previously was the case.

Based on the experience following one large survey we have reason to believe that the percentage of active cases in the non-co-operative segment of the population is higher than that in the co-operative. Seventy-six thousand people (80% of those over 14 years of age) attended the survey and 33 active cases were discovered. Within six months there were 19 active cases reported among the estimated 19,000 who should have attended and did not attend the survey.

People who have presented themselves at previous surveys are not as prone to appreciate the importance of attending repeat surveys, and education may be bringing out those who have been negligent in the past.

In discussing known incidence we must realize that diagnostic facilities have greatly increased in the last ten years. In 1943 there were 165,000 people given x-ray films of the lungs by organized case-finding agencies while in 1952 there were well over one million.

The increase in the number of readmissions to sanatorium is frequently mentioned as a matter of concern. In Table II, shown above, the readmission rate per 100,000 population shows no appreciable change over the ten-year period 1943–1952.

One of the most difficult and complex problems met with in the control of tuberculosis is reactivation of the disease. There are many factors involved, such as the extent of disease when first diagnosed and the socio-economic

level and environment of the patient, the duration of treatment and adaptability to sanatorium regime, and occupation following discharge from sanatorium.

A review was made in 1951 of a cross-section of discharges from sanatoria in Ontario since 1940. It was found that less than 17% were readmitted to sanatorium within 5 years of their original discharge and only 21% within 10 years. These were patients treated before the use of antibiotics and the present reactivation rate may be somewhat less than these figures.

The question is asked frequently, What has been the effect of immigration on the problem of tuberculosis? In so far as Ontario is concerned there was a high incidence of tuberculosis in those entering the province during 1947 and 1948. Since then tuberculosis occurring among immigrants has gradually declined and now is coming closer into line with that in the non-immigrant population. Table IV indicates that the first two years after arrival is the period in which active disease is most likely to develop.

TABLE IV

IMMIGRANTS ADMITTED TO ONTARIO SANATORIA
1948–1953

(Period in Canada Prior to Admission)

Under 1 year	358	31.7%
1 to 2 years	306	27.1
2 to 3 years	224	19.9
3 to 4 years	146	12.9
4 to 5 years	95	8.4
	1129	100.0%

TABLE V

ADMISSIONS TO SANATORIA
IMMIGRANT AND NON-IMMIGRANT POPULATION

Rate per 1,000 Population

Year	Immigrant		Non-immigrant	
	Number	Rate	Number	Rate
1949	142	.81	2,079	.49
1950	194	.90	2,060	.48
1951	209	.65	2,001	.47
1952	246	.60	1,979	.45
1953*	273	.50	2,177	.49

*Tentative figures.

There has been a striking change in the tuberculosis picture over the past twenty-five years. A marked shift from female to male and also towards the older age groups both regarding morbidity and mortality has occurred. Tuberculosis is becoming increasingly a disease of people over 50 years of age and especially is this so in respect to males.

In 1928, 994 females and 888 males died of tuberculosis—a ratio of 1.1 to 1. The following year a change became evident and for the first time deaths in males predominated, 924 to 779 females. The disparity has increased each

year until in 1952 there were 118 deaths among females and 280 among males—a ratio of 1 to 2.3.

When the age factor is considered, another radical change is observed. In 1933 there were 581 persons 40 years of age and over, who died of tuberculosis as against 883 under 40 years, a ratio of 1 to 1.5. Twenty years later, in 1952, 286 persons 40 years and over died of tuberculosis and only 112 under 40 years—a ratio of 2.5 to 1.

The change has been most apparent in males, as shown in Table VI. The ratio 40 years and over to under 40 increased almost 4 times.

In 1945, 15.7% of all admissions to sanatoria were 50 years of age and over as compared to 25.3% in 1952; 78% of those over 50 years were males.

Before tuberculosis can be treated, it must be found. Herein lies one of the greatest problems: how to discover the unsuspected case so that the spread of infection can be prevented. The medical practitioner has been and always will be the single most important factor in finding tuberculosis. In a recent survey

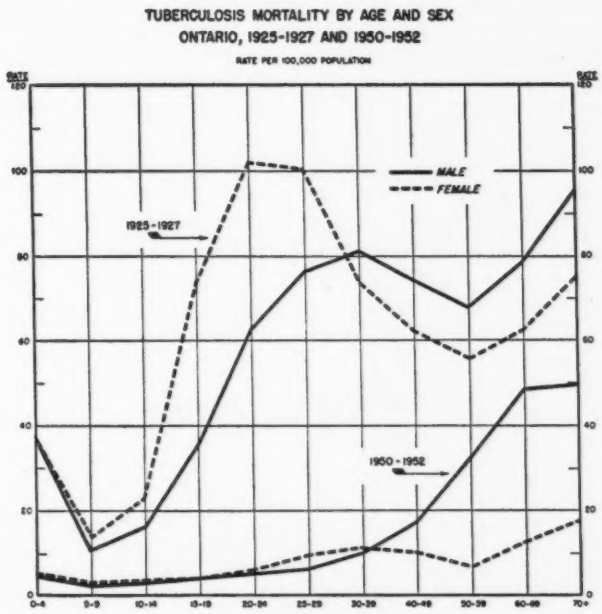


CHART 2

TABLE VI

RATIO OF DEATHS FROM TUBERCULOSIS UNDER 40 YEARS OF AGE AS COMPARED TO OVER 40 YEARS OF AGE IN 20 YEAR PERIOD

	1933			1953		
	Under 40		40 and over	Under 40		40 and over
Males	1.2	to	1	1	to	4
Females	2	to	1	1	to	1
TOTALS	1.5	to	1	1	to	2.5

it was found that private physicians actually made the diagnosis of active tuberculosis in their own offices in 18% of patients entering sanatorium for the first time. In addition they were indirectly involved in the diagnosis of another 40%. To supplement and assist the private physician there are numerous diagnostic public health services available.

TABLE VII

SOURCE OF DIAGNOSIS
APRIL 1, 1951 – MARCH 31, 1952
FIRST ADMISSIONS TO SANATORIUM

Actual Diagnosis of Active Tuberculosis Made By:	
(1) Private physicians in their own offices	18%
(2) Private consultants	7%
(3) Chest Clinics	38%
(4) General Hospitals (in-patients)	21%
(5) Mass X-Ray Surveys	16%
	100%

Until such time as some means is discovered to prevent tuberculosis which is as effective as the vaccine for smallpox, the x-ray remains our main weapon in the fight against tuberculosis in so far as finding the unsuspected case is concerned. It is now possible to utilize this medium in a variety of ways—mass community surveys, the hospital admission x-ray program, routine chest films of special groups such as new employees in industry, food handlers, and New Canadians. It is recognized, of course, that the chest clinic, free to the public and physician, is basic in the control of tuberculosis.

Table VIII illustrates the splendid co-operation of general hospital authorities is one case-finding project, namely, the hospital chest x-ray program. Seventy-nine per cent of all general hospitals in the province reported last December a coverage of 70% and over of patients routinely x-rayed.

TABLE VIII

HOSPITAL ADMISSION CHEST X-RAY PROGRAM
QUARTER ENDING DECEMBER 31, 1953
PROVINCE OF ONTARIO

PERCENTAGE COVERAGE OF IN-PATIENTS X-RAYED
RED CROSS OUTPOSTS AND PRIVATE HOSPITALS EXCLUDED

Percentage Coverage	General Hospitals	Per cent of all Hospitals Reporting
90%–100%	29	21.4%
80%– 89%	55	40.7%
70%– 79%	23	17.0%
60%– 69%	12	8.9%
50%–and under	16	12.0%
TOTAL	135	100%
70% and over coverage	107	79% of all hospitals reporting

The cost of tuberculosis, in Ontario, excluding loss of wages, purchasing power and productivity of patients unable to work, has been estimated to be close to twelve million dollars annually (Table IX). This is a large amount of money to combat but one disease.

TABLE IX

COST OF TUBERCULOSIS—ONTARIO
1952

1. PROVINCIAL GOVERNMENT			
(*a*) Department of Health			
1. Treatment	$6,596,838		
2. Capital Grants to Sanatoria	284,000		
3. Compensation for Tuberculosis—Hospital Employees	103,646		
4. Division of Tuberculosis Prevention	414,067		
		$7,398,551	
(*b*) Department of Welfare—Mothers' Allowances		417,000	
(*c*) Department of Education		94,000	
Total Provincial Government Contribution			$7,909,751
2. *OTHER AGENCIES			
(*a*) Municipalities—Post-Sanatorium Care		422,400	
**(*b*) In-Patient Sanatorium Treatment		1,500,706	
(*c*) Federal Capital Grants to Sanatoria (includes a carry-over from 1951–52 of $260,000)		371,711	
(*d*) Federal Health Grants Utilized		781,850	
(*e*) Voluntary Christmas Seal Contributions		729,800	
			3,806,467
TOTAL COST			$11,716,218

*Does not include that portion of the budget of local Boards of Health devoted to the control of tuberculosis on the municipal or county health unit level.

**Includes payments made for maintenance by Workmen's Compensation Board, Department of Veterans Affairs, Indian Health Services, and prepaid hospital insurance plans.

From the foregoing it is apparent that there is no basis for a feeling of complacency by all those interested, regarding the present tuberculosis situation. Such an attitude might well nullify progress in the past. Treatment facilities appear to be adequate for the present but the challenge is to bring to light all unknown cases of tuberculosis. To do so, every possible approach must be developed to the maximum. No one group of itself can hope to cope successfully with the problem. It requires the full co-operation of all—the official and the voluntary agencies, the medical and nursing professions, as well as the general public.

Studies on Pathogenic Staphylococcal Infections

II. INCIDENCE OF PENICILLIN-RESISTANT STRAINS IN YOUNG HEALTHY CARRIERS AND IN CLINICAL INFECTIONS TREATED AND NOT TREATED WITH PENICILLIN

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IN recent years, penicillin has been indiscriminately used in infections of various etiologies. The initial successful results obtained in staphylococcal infections were soon followed by increasing numerous therapeutic failures. Correspondingly, "in vitro" sensitivity tests revealed a rapid rise in the number of resistant strains encountered. In England, Barber and Dowzenko (1) reported an alarming increase of these strains in hospital patients, from 14% in 1946 to 38% in 1947 and 59% in 1948. A similar situation was observed in all countries where penicillin therapy has become widespread. As expected, cross-infections accounted for an alarming spread of infections in surgical, obstetrical and pediatric wards. Numerous studies demonstrated an accompanying increase in nose and throat carriers in hospital staffs, particularly nurses. Thus, Rountree and Barbour (2) noted a 20% increase in carriers in new nurses within five weeks of their arrival.

In a previous paper (3), we reported a 36.8% staphylococcus carrier rate in young healthy children. This report will consider the penicillin sensitivity of these carrier strains as compared with strains isolated from cases treated and not treated with penicillin. Strains isolated from clinical material will also be studied as to their susceptibility to other antibiotics currently used.

MATERIAL AND METHODS

Our material consisted of 1,970 coagulase-positive strains as follows: 1,110 strains isolated from nose and throat of young healthy carriers, 760 strains from patients treated with penicillin, and 100 strains from cases not treated with penicillin. Staphylococci from carriers were isolated at the Division of Laboratories, Quebec Ministry of Health; those from cases treated with penicillin at Hôpital Pasteur, Montreal, and those from cases not treated with penicillin at the Institute of Microbiology and Hygiene of the University of Montreal.

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This study was partly carried out with funds made available by the Ministry of Health, Province of Quebec (Federal—Provincial Research Health Grants).

The tests for antibiotic sensitivity were done in the following manner: (*a*) pure cultures were inoculated in nutrient broth for 16 to 18 hours at 37° C.; (*b*) one 2 mm. loopful of culture was streaked in a circular manner on a tryptose agar plate; (*c*) in the centre of each circular inoculated area, one disk (Difco) containing a given concentration of antibiotic was placed; (*d*) results were read after incubation overnight at 37° C.

Since antibiotic disks were used at three concentrations, this method permitted the inoculation of five different strains per plate, and a series of three plates made possible the testing of five strains at three concentrations of a given antibiotic. The antibiotic concentrations used were: penicillin, 0.5, 1 and 10 units; streptomycin, 0.1, 1 and 10 micrograms; aureomycin, 10, 30 and 60 micrograms; chloromycetin, 10, 30 and 60 micrograms; terramycin, 10, 30 and 60 micrograms; and bacitracin, 2, 10 and 20 units. Erythromycin disks were used at a concentration of 10 micrograms.

Zones of inhibition of 3 mm. or more were considered an indication of sensitivity at the given concentration. The final interpretation of results was made according to the findings recorded with the three concentrations of a given antibiotic. A strain was found sensitive when significant inhibition was noted at all concentrations or at the two lowest concentrations. A strain was found moderately sensitive when inhibition occurred only in the highest concentration. A resistant strain was one which showed no inhibition at any concentration.

Results

The penicillin sensitivities of pathogenic staphylococci isolated during this study are shown in Table I. These results indicate that the majority of carrier

TABLE I

Penicillin Sensitivity of Coagulase-positive Staphylococci

	Number of strains	Sensitive		Mod. sensitive		Resistant	
		No.	%	No.	%	No.	%
Carriers	1110	1000	90.1	28	2.5	82	7.4
Penicillin-treated cases	760	171	22.5	47	6.2	542	71.3
Untreated cases	100	24	24	18	18	58	58

strains (90.1%) are sensitive to penicillin while the majority of strains from clinical cases (71.3 and 58%) are resistant to this antibiotic.

Eighty-two penicillin-resistant strains were isolated from 75 healthy carriers. Thirty-one children had resistant strains in the nose, while 37 had resistant strains in the throat. Seven children were harbouring resistant strains in both nose and throat.

Although routine tests for susceptibility to antibiotics other than penicillin could not be performed on carrier strains, most of the strains isolated from cases were tested for sensitivity to streptomycin, aureomycin, chloromycetin, terramycin, and bacitracin. In 1953, 139 strains from treated cases were tested against erythromycin, with these results: sensitive, 127 (91.4%); resistant, 12 (8.6%). The results of the other tests are summarized in Table II.

TABLE II

SENSITIVITIES OF PATHOGENIC STAPHYLOCOCCI TO OTHER ANTIBIOTICS

	Dihydrostreptomycin			Chloromycetin			Aureomycin			Terramycin			Bacitracin		
	S	MS	R	S	MS	R	S	MS	R	S	MS	R	S	MS	R
Penicillin treated cases	297	148	315	649	27	84	432	19	277	429	20	279	637	37	54
	39%	19.5%	43.5%	85.4%	3.5%	11.1%	59.3%	2.6%	38.1%	58.9%	2.8%	38.3%	87.5%	5.1%	7.4%
Cases not treated with penicillin	42	23	35	87	4	9	67	1	32	58	6	36			
	42%	23%	35%	87%	4%	9%	67%	1%	32%	58%	6%	36%	—	—	—

S: Sensitive MS: Moderately sensitive R: Resistant

DISCUSSION

Methods

As previously stated, a disk method was used for the determination of sensitivity to antibiotics. Since the validity of this method has been questioned in a statement widely distributed by one of the manufacturers of antibiotics, we believe that some comment is in order. There is no doubt that the tube-dilution method is the best available method for quantitative "in vitro" measures of sensitivity. It is felt, however, that this test is applicable in research work or in clinical cases such as bacterial endocarditis where accurate sensitivity determinations are indicated. For routine diagnostic work and epidemiological studies, this dilution procedure is subject to serious limitations, such as the amount of time and material involved.

Whereas the disk method as routinely performed gives only qualitative measures of sensitivity, this procedure can furnish quantitative estimations under carefully controlled conditions such as isolation of pure cultures, uniformity in the composition, age and physical properties of media used, equal size of inoculum, similar incubation conditions and correct interpretation of results. Other variable factors such as the rates of diffusion and deterioration of antibiotics, constitute the important difficulties inherent in any method of antibiotic sensitivity testing. All these factors also play a role in the tube-dilution method, which necessitates exact techniques and statistical control to avoid large errors. By the same token, since "in vitro" sensitivities do not parallel "in vivo" sensitivities, quantitative mathematical expressions such as those obtained by the tube-dilution test may invite undue reliance on these results.

Investigators (4, 5, 6) who evaluated both methods, obtained closely similar results. An accumulating amount of evidence which cannot be reviewed here indicates that the paper-disk method offers a simple, practical and rapid means of evaluating the relative sensitivity of a given microorganism to various antibiotics. Quite often, negative information will prove as important as positive in saving time and expense in treatment.

Results

This study brings out clearly two points: First, pathogenic staphylococci isolated from healthy carriers show a remarkably low rate of resistance to penicillin. Second, pathogenic staphylococci isolated from clinical cases present a high rate of penicillin-resistance. These conclusions are in accordance with findings reported elsewhere. Thus, Voureka and Hughes (7), examining patients from a London out-patient asthma clinic, found 7.6% of pathogenic staphylococci resistant to penicillin. In Norway, Vogelsang (8) found only 3.9% of 1,304 strains isolated from healthy children to be penicillin-resistant. In sharp contrast with these results are the findings obtained by Martyn (9), and Castillo and Maggia (10), in carriage rate among healthy new-born babies in hospitals: the former found 50% carriers of whom 55.5% were harbouring penicillin-resistant strains; the latter found 80% carriers and 62% resistant strains. Similarly, Rountree and Barbour (2) reported a carriage rate in hospital nurses of 71.4%, with 32.1% having penicillin-resistant strains. As early as 1949, a comprehensive study reported by Rountree and Thomson (11) gave these interesting results: penicillin-resistant strains in hospitalized patients, 53%; in hospital personnel, 32%; and from individuals from a blood-donor clinic, 4%.

The low percentages of penicillin susceptibility among the staphylococci isolated from clinical cases are in accordance with the findings reported in the literature. As expected, strains from cases previously treated with penicillin show a higher rate of resistance to penicillin (71.3%) than strains from untreated cases (58%). This difference in rate is, however, only relative and one might infer that approximately half of these non-treated cases were cross-infections acquired from clinical cases or healthy carriers harbouring penicillin-resistant staphylococci.

A similar situation apparently exists in France, where Chabbert and Terrial (12) found in 1951 that 55% of non-hospitalized patients had penicillin-resistant strains, whereas 75% of hospitalized patients had such strains.

No doubt the widespread use of penicillin is responsible for this situation, since the studies of Boe and Vogelsang (13) in Norway, where this therapy has been much more restricted, gave the following results of penicillin-resistance: strains before penicillin treatment, 15.5%; after treatment, 68.1%. In 1949, Forbes (14) observed a somewhat similar situation in England: patients with staphylococcal lesions from outside the hospital, 12.5% resistant; and hospitalized patients, 68.4% resistant.

As previously reported (3), our nose carriers were approximately six times more numerous than throat carriers. A statistical compilation of our data would indicate, however, that, at least in the group examined, penicillin-resistant strains were much more common in throat carriers (21.1%) than in nose carriers (4.5%). The implications involved will be more fully discussed in the third paper of this series dealing with bacteriophage typing of these strains. These results confirm the belief that the so-called "wild" staphylococci carried by the population at large are infrequently penicillin-resistant, but that strains from individuals when treated with penicillin, or hospitalized in an institution where staphylococcal infections are prevalent, or from indi-

viduals working in these institutions, are likely to harbour resistant varieties of staphylococci.

An overall evaluation of our antibiotic "in vitro" tests indicates that chloromycetin was the most effective, followed by aureomycin and terramycin and, finally, streptomycin and penicillin. Bacitracin is obviously the antibiotic of choice for local treatment. In view of our limited experience with erythromycin, although this antibiotic seemed to be the most effective against staphylococci, we believe that caution in its use is indicated because of possible future development of erythromycin-resistant strains.

As noted in the literature, a marked cross-resistance was found with aureomycin and terramycin. From 1949 to 1953, no special increase in resistance for penicillin was noted. In 1949, however, many strains were sensitive to all antibiotics or resistant to penicillin only. In 1950, different patterns were often observed, such as strains resistant to penicillin and streptomycin. In 1952, a large number of strains were sensitive only to chloromycetin and bacitracin; and in 1953, three strains were found to be resistant to all antibiotics. This fact poses a therapeutic problem difficult to solve.

Clinical Correlation

A serious objection to "in vitro" methods has been the observation that clinical results very often do not parallel laboratory tests. Our personal experience, supported by recent reports such as those of Broom et al., 1952 (4), and Weil and Harris, 1953 (15), had shown in the great majority of cases a good correlation between clinical experience and laboratory data. In this study, unsuccessful home treatment with penicillin motivated the hospitalization of most of the patients. "In vitro" tests proved that the majority of staphylococcal strains isolated were resistant to penicillin, and a change to an antibiotic effective against the particular strain usually resulted in a clinical recovery. Non-correlation was usually found where anatomical or pathological factors prevented an effective distribution of the antibiotic. Another source of seemingly clinical discrepancy is encountered when the microorganism tested has no etiologic significance. This situation was experienced when a blood culture from a patient suspected of suffering from a septicemia yielded a golden staphylococcus resistant to aureomycin and sensitive to penicillin. Subsequent penicillotherapy did not produce any beneficial effect, and the substitution of aureomycin resulted in the recovery of the patient. In the meantime, more exact clinical evaluation pointed to a diagnosis of pyelonephritis and the organism isolated from the urine was a colibacillus resistant to penicillin and sensitive to aureomycin. Obviously, the staphylococcus isolated previously was a skin contaminant. The tendency to use high dosages of antibiotics, for instance penicillin in doses of 1 to 25 million units daily, is another factor which may cause false interpretation of "in vitro" tests, since an organism found resistant to 1 unit of penicillin might be sensitive to this antibiotic if the serum concentration can be sufficiently increased.

Summary

1. Penicillin-sensitivity tests, using a disk method, were done on 1,110 staphylococcal strains isolated from the naso-pharynx of young healthy

carriers. Similar tests were performed on 760 pathogenic staphylococci isolated from cases previously treated with penicillin and on 100 strains from cases not treated with this antibiotic. Testing of the last two categories for antibiotic sensitivity was also done with dihydrostreptomycin, chloromycetin, aureomycin, terramycin and bacitracin.

2. Our results indicate that the majority of carrier strains (90.1%) are sensitive to penicillin, whereas the majority of strains isolated from treated cases (71.3%) and non-treated cases (58%) are penicillin-resistant.

3. Sensitivity tests done on strains from clinical cases, whether treated or not treated, did not show any statistical differences between the two categories, implying that probably half of present infections are due to cross-infections by resistant strains. Our data indicate that the degree of effectiveness of antibiotics used may be: first choice, chloromycetin, followed by aureomycin and terramycin; and as third choice, dihydrostreptomycin and penicillin. Limited studies done with erythromycin show that this antibiotic appears, for the time being, the most effective antibiotic. Bacitracin still remains the drug of choice for local treatment.

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Oil Partition for the Collection of Small Numbers of Tubercle Bacilli from Aqueous Suspensions

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THE extensive use of various techniques for the detection of tuberculosis in apparently healthy persons has intensified the need for improved bacteriological methods. The concentration of small numbers of tubercle bacilli from pathological material into a final compact volume presents difficulties involved in the homogenization of the specimen, the destruction of contaminating organisms, and the collection of the bacilli. The passage of acid-fast bacilli into lipoidal solvents has been reported to be a more efficient and reliable method of collection than the more widely used methods of centrifugation and flocculation (Andrus and MacMahon, 1924; Pottenger, 1931; Nagy, 1939; Hanks and Feldman, 1940; and Robinson and Stovall, 1941). The method was introduced by Couratte-Arnaude (1903), using ether with a flotation technique, and has heretofore been limited to direct smear examination because of the lethal activity and the difficulty of removal of the ether. An investigation of oil partition was undertaken in an effort to develop a cultural method which would consistently reveal small numbers of bacilli. It was proposed to eliminate the existing drawbacks by employing oil for the collection of the mycobacteria and removing the oil by solution in fat solvents with filtration through a filter membrane, which would retain the bacilli for cultivation.

In a study of the relationship of surface tension to phagocytosis, Mudd and Mudd (1924, 1927) observed that acid-fast bacilli pass with regularity and spontaneity into oil, from a suspension in the water phase of a water-oil emulsion, in contradistinction to non-acid-fast bacteria which either remain in the interface or return to the water phase. Mudd and Mudd inferred that the behaviour of the tubercle bacilli was due to the presence of fatty substances on the surfaces of the bacilli with many non-polar groups which prevented their being wetted by water and allowed them to be wetted by the non-polar liquid oil. Reed and Rice (1931) confirmed the spontaneous passage of acid-fast bacilli into oil with studies based on a comparison of opacity of heavy

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suspensions of bacteria. Their results showed that 95 per cent of the bacilli were partitioned into oil, whereas non-acid-fast bacteria did not pass into the oil.

EXPERIMENTAL

The Partition into Oil of Acid-Fast Bacilli tested by Indirect Method

Dilute suspensions of the test organisms, *Mycobacterium tuberculosis* strains B.C.G. and H37Rv, were prepared directly from seven- to ten-day-old cultures in Tween albumin medium (Dubos and Middlebrook, 1947). The numbers of bacilli were standardized by direct count with a Thoma-Hawksley counting chamber to contain from 10^1 to 10^9 acid-fast bacilli, in ten-fold increments, suspended in ten-cc. volumes of isotonic saline (KH_2PO_4 0.2 gm., Na_2HPO_4. 12H2O 1.4 gm., and NaCl 1.5 g., in 1000 cc. distilled water) and each test was carried out in triplicate. The following oils were tested: castor, olive, cottonseed, peanut, corn, sesame, and mineral oil. They were added in 0.75-cc. quantity to the bacillary suspensions which had been placed in vaccine bottles of 20-cc. capacity and capped with pull-over rubber stoppers. Following shaking in a Kahn shaker for five minutes, the vaccine bottles were centrifuged for ten minutes at 1,500 r.p.m. in an inverted position to insure that residual oil was not withdrawn with the aqueous phase, which was removed with a syringe. Three portions of 0.15 cc. were transferred, using calibrated capillary pipettes, to separate tubes containing Loewenstein's medium. Control tests, in which oil was omitted from the bacillary suspensions, were carried out with each experiment. All tubes were incubated at 37°C. and examined weekly for the presence of typical growth. The results after six weeks' observation are recorded in Table I.

A series of suspensions containing 10^9, 10^8, 10^7, 10^6, 10^5 and 10^4 BCG bacilli per 10 cc. were used for comparing the collecting capacity of castor, olive, cottonseed, and peanut oils, which was measured by the growth from plantings of aliquots from the aqueous phase. Corn, sesame, and paraffin oils were later tested with 10^7, 10^6, 10^5 and 10^4 bacilli. The results showed no significant differences between the various oils.

Assuming that the degree of growth varied according to the number of bacilli remaining in the suspension, collection seems to be complete from the aqueous suspensions containing 10^5 or 10^4 bacilli with any of the seven oils tested. The deviation in growth from the control in densities between 10^6 and 10^8 may mean either an actual diminution of bacilli or some degree of toxicity of the particular oil, with no appreciable collection at 10^9 bacilli regardless of the kind of oil. A repeat series using H37Rv as the test organism showed similar results with the oil collecting all the acid-fast bacilli from suspensions containing less than 10^6 bacilli per ten-cc. volume.

TABLE I

THE EFFECT OF VARIOUS OILS ON THE PARTITION OF GRADED NUMBERS OF ACID-FAST BACILLI

No. B.C.G.	10^9	10^9	10^9	10^8	10^8	10^7	10^6	10^6	10^5	10^5	10^4	10^4
OILS												
Castor	***	***	***	**	**	—	*	*	ng	ng	ng	ng
Olive	***	***	***	*	*	sl.	sl.	ng	ng	ng	ng	ng
Cottonseed	***	**	***	ng	ng	—	*	*	ng	ng	ng	ng
Peanut	**	***	***	**	**	*	sl.	sl.	ng	ng	ng	ng
Corn	—	—	—	—	—	**	—	—	ng	ng	ng	ng
Sesame	—	—	—	—	—	*	—	—	ng	ng	ng	ng
Paraffin	—	—	—	—	—	*	sl.	ng	ng	ng	ng	ng
Control Saline	***	***	***	***	***	***	***	***	**	**	**	**

The number of *'s indicates the amount of growth obtained from plantings of the aqueous phase; ng denotes no visible growth—omitted.

Buffered solutions ranging from pH 3.0 to pH 7.0, using disodium phosphate and citric acid, were substituted for isotonic saline in similar experiments to determine the effect of variations

in hydrogen ion concentration, without altering the results in any way. Variation of the amount of oil from 0.5 to 2.0 cc. for each ten-cc. volume of suspension of bacilli did not result in any change in the degree of partition.

Equal volumes of 10 per cent trisodium phosphate (23 per cent $Na_3PO_4.12H_2O$) and isotonic saline were used to prepare bacillary suspensions which were allowed to remain at room temperature for 18 hours before the addition of oil. The examination of trisodium phosphate as the suspending medium is necessary because of its value in eliminating organisms other than tubercle bacilli from specimens. The remainder of the procedure was carried out as described above. The results are recorded in Table II. A series of suspensions of BCG and H37Rv with 10^6 and 10^8 bacilli in 10 cc. were set up and shaken to allow partition with olive or paraffin oil. The results showed that in nine series of tests with trisodium-phosphate suspensions no growth was observed in any of the samples from the aqueous phase. However, four of the nine saline suspensions developed colonies on culture; that is, all three samples in two series with 10^8 bacilli, and one out of three samples in two series with 10^6 bacilli. The yield of growth varied according to the number of organisms in suspension and no differences were observed between BCG and H37Rv.

TABLE II

THE EFFECT OF TRISODIUM PHOSPHATE ON THE OIL PARTITION OF ACID-FAST BACILLI

Saline cc.	5	5	5	10	10	10	No Oil 10
Trisodium Phos. 10% cc.	5	5	5	0	0	0	0
No. of Bacilli							
Olive Oil							
10^6 B.C.G.	ng	ng	ng	ng	ng	ng	*
10^8 B.C.G.	ng	ng	ng	ng	ng	ng	***
10^6 H37Rv	ng	ng	ng	ng	ng	*	***
10^6 H37Rv	ng	ng	—	ng	ng	—	*
10^8 H37Rv	ng	ng	—	**	**	**	***
10^8 H37Rv	ng	ng	—	**	**	**	***
Paraffin Oil							
10^6 H37Rv	ng	ng	ng	ng	ng	ng	**
10^6 H37Rv	ng	ng	ng	ng	ng	*	*
10^6 H37Rv	ng	ng	ng	ng	ng	ng	***

The number of *'s indicates the amount of growth from plantings of the aqueous phase; ng denotes no growth — omitted.

The Partition into Oil of Non-acid-fast Bacteria

Suspensions in isotonic saline of *Proteus mirabilis*, *Micrococcus epidermidis*, *Escherichia coli*, and *Streptococcus salivarius* were prepared to contain approximately 10^6 microorganisms per 10 cc. Oil partition was carried out in a manner similar to that followed for acid-fast bacilli except that 0.05-cc. samples from the olive oil as well as the aqueous phase were inoculated on blood-agar plates, in order to determine whether the oil contained any non-acid-fast bacteria. The growths observed after eighteen hours' incubation are recorded in Table III. Heavy growths were obtained from all samples of oils except for *Proteus mirabilis*, which showed no growth from two series and a light growth from the third. Samples from the aqueous phase of the Micrococci failed to develop colonies in all three series, but the remaining organisms showed good growth from the water phase. There appeared to be some selectivity according to species, Proteus for the most part not being partitioned into the oil, and the Micrococci, like the Mycobacteria, being completely collected into the oil. Varying the hydrogen ion concentration from pH 3.0 to pH 7.0 had no effect on the partition of non-acid-fast micro-organisms.

The Partition into Oil of Acid-Fast Bacilli Tested by Animal Inoculation

Five series of bacillary suspensions in saline were prepared to contain 1–10, 10–100, 100–1,000, 1,000–10,000, and 10,000–100,000 bacilli of a virulent strain of human Mycobacterium. Olive

TABLE III

THE PARTITION INTO OIL OF NON-ACID-FAST MICRO-ORGANISMS

Organism	*Escherichia coli*			*Strep. salvarius*			*Proteus mirabilis*			*Micrococcus epidermidis*		
Series	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
Oil	***	*	***	***	*	***	ng	ng	*	***	***	***
Aqueous phase	***	*	***	***	*	***	***	***	***	ng	ng	ng
Control Saline	***	***	***	***	*	***	***	***	***	***	***	***

The number of *'s indicates the amount of growth; ng, no growth.

oil was added in 0.5-cc. amounts and the usual procedure was followed, except that the vaccine bottles were centrifuged in an upright position so that the oil was withdrawn into a syringe with a needle 1½" long, without passing into the aqueous phase. The oil was injected into the left groin of guinea-pigs subcutaneously, the tests being carried out in triplicate. The guinea-pigs were autopsied after eight weeks. The lesions observed are recorded in Table IV. Numerical values are assigned to each organ in proportion to the extent and severity of tuberculosis. All the guinea-pigs injected with oil from suspensions containing 100 to 1,000 or more bacilli showed extensive tuberculosis after eight weeks; two of the three guinea-pigs with suspensions containing 10 to 100 bacilli showed moderate lesions; and one of the three animals from oil with a suspension containing 1 to 10 bacilli developed an enlarged and caseous lymph gland. The development of tuberculous lesions in guinea-pigs confirmed that partition into oil is a precise method of collecting tubercle bacilli from suspensions containing small numbers, with full retention of virulence and viability.

TABLE IV

THE EXTENT OF TUBERCULOSIS IN GUINEA-PIGS FROM INJECTION OF OILS USED TO PARTITION TUBERCLE BACILLI FROM SALINE SUSPENSIONS

No. of Bacilli in Sal. Oil Susp.	1–10		10–100		100–1000		1000–10,000		10,000–100,000	
Guinea-pig #1	Spleen	—	Spleen	**	Spleen	***	Spleen	***	Spleen	***
	Liver	—	Liver	—	Liver	**	Liver	**	Liver	***
	Inguinal Gland	—	Inguinal Gland	***	Inguinal Gland	***	Inguinal Gland	***	Inguinal Gland	***
Guinea-pig #2	Spleen	—	Spleen	***	Spleen	***	Spleen	***	Spleen	***
	Liver	—	Liver	—	Liver	*	Liver	*	Liver	***
	Inguinal Gland	—	Inguinal Gland	***	Inguinal Gland	—	Inguinal Gland	***	Inguinal Gland	***
Guinea-pig #3	Spleen	—	Spleen	—	Spleen	**	Spleen	***	Spleen	***
	Liver	—	Liver	—	Liver	—	Liver	**	Liver	***
	Inguinal Gland	***	Inguinal Gland	—	Inguinal Gland	***	Inguinal Gland	***	Inguinal Gland	***

The number of *'s indicates the extent and severity of tuberculosis in the organs.

The Partition into Oil of Acid-Fast Bacilli Tested by Direct Method

Repeating the procedure outlined under indirect method, the oil was collected into separatory funnels of 20-cc. capacity by drawing off the underlying water phase, dissolved in a mixture of ten cc. of acetone and ten cc. of petroleum ether, which resulted in a clear solution, and then filtered through Cellafilter membranes, which are insoluble in fat solvents. These membranes were obtained from Membran-Gesellshaft, Göttingen, Germany. The membranes were held in a filter apparatus specially designed for filtration of small amounts of fluids. The membrane was washed with buffered saline pH 6.5 before planting on Petragnani's medium, to insure contact with the medium. A control series was carried out with saline suspensions, omitting the

oil and fat solvents. Growth of visible colonies occurred only rarely on the membranes used to collect the bacilli following the filtration of the oil-fat-solvent solution, although examination of the membranes by stained smears showed the presence of acid-fast bacilli. This seems to indicate injury to the oil-partitioned organisms preventing growth.

Bactericidal Effect of Various Oils on Minimal Numbers of Tubercle Bacilli

Schleicher and Schull discs No. 740-E, available for the assay of antibacterial substances, were cut in two, sterilized, dried, and impregnated with 10^2, 10^4, 10^6 and 10^8 bacilli of H37Rv, using a calibrated capillary pipette. The discs were dried overnight at 37°C. before being placed in petri plates containing the following vegetable oils: soybean, rapeseed, sesame, cottonseed, linseed, olive, coconut, and wheat germ. Pure oils were received from Brickman and Company and sterilized by filtration through membrane filters. Following exposure for twenty minutes, the discs were removed from the oil and allowed to drain. The discs containing residual amounts of oil were then planted on tubes containing Petragnani's medium. Three samples were tested with each oil and growth was observed weekly (Table V).

TABLE V

THE ACTION OF VARIOUS OILS ON THE GROWTH OF MINIMAL NUMBERS OF TUBERCLE BACILLI

Type of Oil	Soybean	Rapeseed	Sesame	Cottonseed	Linseed
No. Bacilli Viable	10^2	—	—	10^2	10^2 (1 out of 3)
Not Viable	—	10^8	10^8	—	10^2 (2 out of 3)

Type of Oil	Castor	Olive	Coconut	Wheat Germ	Control Sal.
No. of Bacilli giving growth	10^2	10^6 (1 out of 3)	10^2	—	10^2
No. of Bacilli not giving growth	—	10^4	—	10^8	—

The strain H37Rv was used. Each result represents three trials unless stated. Period of exposure was twenty minutes.

A similar procedure was carried out with a second series of discs except that, following exposure to the oils, the discs were placed in 10 cc. of acetone contained in petri plates for a further period of twenty minutes. The addition of 10 cc. of petroleum ether to the acetone was necessary to dissolve the castor oil. The discs were drained and allowed to dry before planting on Petragnani's medium.

A third series was carried out in which cholesterol was added to olive, paraffin, and coconut oils before exposure of the tubercle bacilli. This was repeated with the phospholipids, cephalin, and the animal and vegetable lecithins dissolved in the oils. The results are recorded in Table VI.

TABLE VI

THE EFFECT OF SATURATING OILS WITH LIPOIDAL MATERIAL ON THE GROWTH OF TUBERCLE BACILLI

Oils	Olive	Mineral Oil	Coconut
No. of Bacilli viable			
with Cholesterol	10^4 (4 out of 4)	10^2 (3 out of 4)	10^2 (2 out of 4)
with Cephalin	10^2 (1 out of 3)	—	10^2 (1 out of 3)
with Lecithin animal	10^3 (1 out of 3)	ng from 10^9	10^5 (1 out of 3)
with Lecithin vegetable	10^7 (1 out of 3)	—	10^9 (1 out of 3)

Each figure represents the smallest number of bacilli surviving in the number of samples tested; ng represents no growth, — omitted.

When minimal numbers of tubercle bacilli were exposed to various oils for twenty minutes (Table V), rapeseed, sesame, and wheat-germ oil showed a definite bactericidal action, since even 10^6 bacilli failed to survive. Olive oil occupied an intermediate position, with three samples of 10^3 and one out of three samples of 10^6 bacilli showing visible growth while no growth was evident with smaller numbers. On the other hand, coconut oil, castor, cottonseed, and soybean appeared to exert little if any bactericidal activity, with all samples of 10^3 developing colonies.

In the repeated experiments in which the bacilli were exposed to acetone following their contact with various oils, no differences in either the rate or amount of growth were observed in any instance with the addition of acetone.

The effect of saturating certain oils with cholesterol, cephalin and lecithin (Table VI) was to try to prevent the solution of lipids from the bacilli, and it proved selective. With olive oil, the addition of cephalin resulted in growth in one tube of 10^2 bacilli; with cholesterol growth occurred in all tubes of 10^4 bacilli; animal lecithin gave growth in one tube of 10^3 bacilli. These results compare favourably with growth in only one sample of 10^6 bacilli using olive oil without the addition of lipids. On the other hand, the animal and vegetable lecithins seem to impart a lethal effect when added to coconut oil, since growth was only obtained from 10^9 and 10^5 bacilli, compared to 10^2 with the pure oil.

Discussion

The spontaneous partition of acid-fast bacilli into oil from a water phase is associated with the hydrophobic and lipophilic properties of the mycobacteria and shows a non-selective activity to different oils. A quantitative relationship between the degree of partition and the numbers of bacilli in the aqueous suspension was demonstrated, with 10^5 or less bacilli being completely collected. With larger numbers there is a slight indication that possibly a proportional number remain in the aqueous phase. Whereas considerable difficulty is encountered with the collection of small numbers of tubercle bacilli by ordinary methods such as centrifugation, oil partition provides a reliable method of collection based on this characteristic of the mycobacteria.

Contrary to the findings of Mudd and Mudd (1927) and Reed and Rice (1931), non-acid-fast micro-organisms were definitely partitioned to some extent into the oil, but there is a species selection. Although the degree of partition may be dependent on the number of bacteria in the suspension, as with the mycobacteria, it was the recovery of the tubercle bacilli with the exclusion of large and variable numbers of non-acid-fast micro-organisms which was hoped for. Therefore, it was concluded that preliminary differential decontamination would have to be accomplished by other means, since the elimination of contaminating organisms by selective behaviour to oil could not be assured. The discrepancies of results compared with those of Reed and Rice, who employed Nephrolometer readings, may be due to the use of cultural techniques and suspensions with much smaller numbers of bacilli.

Irrespective of the method used for the collection of tubercle bacilli from sputa or other clinical material, a preliminary treatment is required. This, as a rule, employs agents to digest the specimen and destroy the secondary organisms, the relatively resistant acid-fast bacilli surviving the treatment. Corper and Stoner (1946), Van Vrancken (1947), Tarshis and Lewis (1949) and Spendlove, Cummings and Patnode (1949) compared various reagents and found trisodium phosphate to be most effective for this purpose. Our finding of an increased degree in which acid-fast bacilli pass from an aqueous phase into

oil, when a 5 per cent solution of trisodium phosphate is used as the suspending fluid, suggests an alteration of the surface of the bacilli by the surface active properties, but it is difficult to reconcile with the detergent activity of the trisodium phosphate which should wet the oil and decrease the degree of partition. However, this finding is an advantage, since trisodium phosphate is widely used for differential sterilization in isolating tubercle bacilli from pathological specimens.

The effect of oil partition in the preceding studies was evaluated using an indirect method, in that the aqueous phase was tested for viable organisms. However, the direct method was used with animal inoculations of oils used for the collection of bacilli from saline suspensions, and the development of tuberculous lesions confirms the spontaneous passage of small numbers of bacilli into oil, with full retention of viability and virulence and absence of very marked inhibitory activity of the oil by *in vivo* testing.

In the method envisaged, the tubercle bacilli were to be recovered on a Membrane filter by dissolving the oil in an organic solvent and removing the oil-fat solvent solution by filtration. It appeared that the relatively high resistance of tubercle bacilli to chemical disinfectants would permit exposure to fat solvents for short periods of time without impairment of viability. In addition, it has been reported that fat solvents such as benzene, toluene, xylene, chloroform, and carbon tetrachloride exert little activity against tubercle bacilli (Dubos, 1945). In a series of tests using a filter-paper disc method with ether, petroleum ether, acetone and benzene, the bacilli survived two hours' exposure to acetone, petroleum ether, and benzene, in that order of preference. On the other hand, ether was bactericidal even after five minutes' exposure. It subsequently proved necessary to use a mixture of acetone and petroleum ether to obtain complete solution of the oil. Although the mixture possessed excellent solvent action, it exerted a marked lethal action on the oil-treated tubercle bacilli and was a major cause of impairment of the viability of the organisms in the filtration step of the oil partition method.

The majority of types of bacterial filtration methods serve to remove bacteria and cannot be adapted for their recovery. Collodion membranes of suitable pore size were prepared by the method of Pierce (1927) but tubercle bacilli failed to develop colonies on the surface of the membranes, as a marked toxicity after autoclaving was exhibited, even to a culture of *Escherichia coli*, presumably due to the ethylene glycol present or to the development of some breakdown product in the membranes. Zsigmondy (1918) developed a special method of processing nitrocellulose and prepared membranes which have been widely used and are available commercially. In addition, a "Cellafilter" type of membrane has been produced which is insoluble in organic solvents. The complete recovery of large numbers of both acid-fast and non-acid-fast micro-organisms was demonstrated by filtration with "Cellafilter" membranes and no toxic effects were observed.

The small number of cultures which retained their viability with the oil partition method suggested either a removal by oil or fat solvents of essential lipoidal constituents or a bactericidal action of the reagents. The addition of various lipids, including extracts of the bacilli, to the media, did not enhance the development of visible colonies from oil treated organisms. Although the

filter-paper disc method may permit a certain amount of mechanical removal of the bacilli by oil, growth was as profuse on non-toxic oil-treated discs as it was on those untreated. Since some oils exerted a marked bactericidal action while others were non-lethal, it would appear that the selection of oil for the partition of acid-fast bacilli is important. This may account for the discrepancy of reports regarding the action of oils on the viability of tubercle bacilli. The addition of cholesterol and cephalin to the oils appeared to minimize their toxic activity. It is interesting to note that Dubos (1945) reports that the phospholipids can protect living cells against many types of injurious agents, including bacterial metabolites and bacteriostatic and bactericidal effects.

A re-examination of the action of acetone and petroleum ether on small numbers of tubercle bacilli, using a filtration method to remove the fat solvents and retain the washed bacilli on a membrane filter, revealed that a combination of acetone and petroleum ether exhibited a marked inhibitory effect on acid-fast bacilli. The problem of dissolving the oil must be elucidated before the oil-partition method can be applied to the collection of tubercle bacilli from sputa.

Summary

The spontaneous oil partition of acid-fast bacilli in water-oil systems was studied to develop a more precise method of laboratory diagnosis. The selection of oil, hydrogen ion concentration, and amount of oil had little effect on passage into oil of tubercle bacilli from an aqueous system. The degree of partition varied according to the number of bacilli in the suspension, with 10^5 or less bacilli being completely taken up by the oil, while invariably some organisms remained in the aqueous phase from suspensions containing larger numbers. Non-acid-fast organisms grew from samples of the oil as well as the water suspension, although there was some selection according to species. The use of a 5 per cent trisodium-phosphate solution as the suspending medium increased the numbers of bacilli taken up into the oil. Guinea-pigs injected with oil from suspensions containing minimal numbers of bacilli showed extensive tuberculosis. The combined use of acetone and petroleum ether required to dissolve the oil into a suitable solution for filtration proved somewhat bactericidal on the tubercle bacilli. Coconut oil, castor, cottonseed, and soybean exerted the least bactericidal activity of the oils tested. The addition of cephalin to olive oil appeared to minimize the toxic activity.

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COMBATING POLIOMYELITIS

THE report by Dr. Cadham, published in this issue, of the very severe outbreak of poliomyelitis in Winnipeg last summer will remind health officers throughout Canada of the seriousness of this disease. The fact is that the incidence has been increasing during the past twenty years and that a larger number of bulbar cases are occurring, with an increasing mortality. It has been noted that there has been a shifting in the age distribution and that, year by year, the incidence among young adults has increased. Further, the prognosis is less favourable in the older age groups. The data presented in this study support these statements. Thirty-seven per cent of cases occurred among persons over 15 years of age. Paralysis was recorded in 59 per cent of the cases. Although there was no marked difference in the percentage of paralysis in each age group, there was considerable variation in the death rate, from a low rate of 1.2 in the 0–9 age group to a high of 28 in the age group over 40.

Of special interest are the data relating to the use of gamma globulin. Of 1,403 contacts who received gamma globulin, 13 were reported as poliomyelitis cases. Three of these had paralysis, an incidence rate for paralytic cases of 2 per 1,000 persons. In the use of this serum it is known that protection is not evidenced until after a week has elapsed and it extends over a period of five or six weeks. All but one of the 13 cases occurred within one week. In 502 contacts who did not receive serum, 13 cases were reported. Ten had paralysis, an incidence of paralytic cases of 19.9 per 1,000.

It is essential that gamma globulin be given in adequate quantities. The amount recommended is 0.1 cc. per kilogram of body weight. This dose was determined in research studies conducted under the auspices of the National Foundation for Infantile Paralysis Incorporated, New York, and confirmed by the observations of Dr. William McD. Hammon in the large-scale trial involving 55,000 children, reported in 1952. The observations also indicated that protection was not evidenced until a week had passed. The findings in regard to dosage and the time interval have frequently been overlooked by physicians, and this may account in part for the inconclusive findings of the committee which recently attempted to evaluate the use of gamma globulin distributed in the United States last year.

At the present time the only means of conferring a measure of protection is the use of gamma globulin. One million seven hundred thousand doses are being made available in the United States by the National Foundation for use in combating poliomyelitis this year. In Canada, the Federal and Provincial Health Departments plan to provide 100,000 doses. Of major concern is the availability of the quantity of blood serum necessary to provide this supply of gamma globulin. The only source is human blood, and the provision of 100,000 doses in Canada during the coming months requires at least 100,000 donations. The collection of these donations is the work of the Canadian Red Cross Society. It is essential that health departments assist the Red Cross in every way in their appeal for donors, thus maintaining the national blood donor program and obtaining the additional hundred thousand donations for the blood fraction program.

Through the co-operation of the Provincial and Federal Departments of Health, a greatly enlarged centre for the preparation of the various protein fractions of plasma, including gamma globulin, albumin, and certain blood-clotting preparations, has been provided. In this new centre, now nearing completion in the Connaught Medical Research Laboratories, protein fractions of blood plasma—of major importance—will be made available for use. As a result, each donation of blood will make its maximum contribution. This will provide albumin for use in surgical shock, fibrin preparations which further the clotting of blood and make possible certain difficult surgical procedures, and gamma globulin for protection in poliomyelitis, infectious hepatitis, measles, and mumps.

In the United States a nation-wide trial is being made of a preventive vaccine against poliomyelitis, developed by Dr. Jonas E. Salk of the University of Pittsburgh. This trial has been made possible by the National Foundation. It is expected that approximately 500,000 children will be given the series of three doses. A large number of children will serve as a control group, receiving three doses of the culture medium without virus. The two preparations are identical in appearance, and the physicians administering the products will not be able to identify them. Altogether, forty-four States are participating in the trial.

The vaccine is prepared from cultures of poliomyelitis virus grown in nutrient medium number 199, developed by Morgan, Morton and Parker, to which are added small pieces of finely minced kidney tissue of monkeys. By this application of tissue culture it has been possible to obtain poliomyelitis viruses of the three known types in quantities sufficiently large to permit the preparation by United States pharmaceutical companies of the amount of vaccine necessary for the present trials. Large quantities of culture fluids were prepared in the Connaught Medical Research Laboratories, under the direction of the National Foundation for Infantile Paralysis.

The administration of the vaccine has been singularly free from reactions. In the preliminary work, antibody titrations of the sera of monkeys which had received vaccine indicated that there was a definite response to the vaccination and, further, that the administration of booster doses after an interval of six months elicited a sharp rise in antibody titres to relatively high levels. Titration of sera of children who received three doses of vaccine, and also of a group

who received a booster dose, have given comparable findings. The evaluation study which is to be conducted is planned to provide essential information and will include extensive serological testing.

As a different approach to the problem of preparing an effective preventive vaccine, studies are being made, in several laboratories in the United States, of the possible protective value of strains of poliomyelitis viruses that have been attenuated. The investigators consider that attenuated living strains may afford protection and that vaccine prepared from inactivated virus, employed in the present large-scale trial, may not be effective. Essential information, it is hoped, will be available next year from the present study. The National Foundation for Infantile Paralysis is to be highly commended for this great contribution and for planning a most comprehensive evaluation program, to be conducted under the direction of Dr. Thomas Francis, Jr., of the School of Public Health, University of Michigan.

THE ONTARIO SANITARY-INSPECTOR TRAINING PROGRAM

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Ontario Sanitary Inspectors' Training Course
Toronto

WITH the expansion of public health services to meet the needs of the growing population of Ontario, it became increasingly apparent that more extensive formal training of sanitary inspectors was desirable. In January 1953 the Department of Health for Ontario introduced a course of instruction for sanitary inspectors, officially known as the Ontario Sanitary Inspectors' Training Course.

The course is financed under a Federal Health Grant. It is of nine months' duration and held in Toronto.

The provision of teaching staff and the administration of the course are controlled by a Departmental Committee. The Departmental Committee is also the nucleus of two other committees on screening and curriculum. The latter committees have representation from the Canadian Institute of Sanitary Inspectors, Ontario Branch, whose advice has been most helpful.

The teaching staff is found from the provincial department, municipal health departments, health units, and practising specialists in medicine, engineering, veterinary medicine, and sanitary inspection. In addition, the School of Hygiene, University of Toronto, is co-operating in the teaching of bacteriology, sanitary chemistry, parasitology, and nutrition. The Provincial Institute of Trades has taught public health aspects of plumbing; and the School of Photographic Arts, Ryerson Institute of Technology, a course in the operation and use of visual aids. Certain industries have extended facilities for the teaching of courses in water treatment and lighting. The services of 63 specialists have been used during the course.

The minimum basic educational requirement for the course is Ontario Secondary School Graduation (Grade XII) with the science option. If the candidate was educated in Ontario, no equivalent standing is accepted. Candidates educated outside Ontario may be accepted if the Ontario Department of Education considers their standing equivalent to the Ontario requirements. Graduation subjects should include mathematics, English, chemistry, physics, and preferably biology. In our present class, students holding senior matriculation with science credits have a distinct advantage.

Candidates are investigated regarding character and standing in their home communities. Their record with previous employers is checked. The candidates are interviewed by the screening committee to determine their personal fitness for training and employment as public officials. Priority is given to applicants who are sponsored by a local health department, with a view to employment on graduation.

Accepted candidates are given a medical examination and are offered protective immunization.

The course is organized to prepare students to write the examinations

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Based on an address given at the annual conference of the Canadian Institute of Sanitary Inspectors, held in Cornwall, Ontario, June 20, 1953.

for the Certificate in Sanitary Inspection (Canada)—C.S.I.(C.), which are set by the Canadian Public Health Association. Training is given in five major divisions:

1. *Public Health Organization, Administration and Legislation*—lectures and demonstrations—including training in the operation and use of audiovisual aids (120 hours).
2. *Preventive Medicine*
   (*a*) Communicable diseases — transmission, control and prevention.
   (*b*) Bacteriology.
   (*c*) Parasitology.
   (*d*) Sanitary chemistry.
   (*e*) Immunology.
   (*f*) Psychology.
   (*g*) Occupational health hazards.
   (*h*) Elementary vital statistics.
   (*i*) Nutrition.

   The course covers 126 hours, of which 72 hours are spent in laboratory and other practical work.
3. *Food Sanitation*
   (*a*) Food poisoning — allergy, chemical poisoning, food intoxication.
   (*b*) Food infections.
   (*c*) Applicable legislation.
   (*d*) Food inspection.

   This course includes 198 hours of lectures, demonstrations and practical instruction.
4. *Environmental Sanitation*
   Water.
   Sewage and sewerage systems.
   Housing.
   Lighting.
   Ventilation and heating.
   Emergency sanitation.
   Refuse disposal.
   School sanitation.
   Nuisances.
   Recreational sanitation.
   Insect and rodent control.

   Office practice (including the preparation and interpretation of reports, plans, field sketches, charts, graphs, and map reading). The field use of the hand optical, spirit and string levels. Calculations commonly used by the sanitary inspector. A review of essential mathematics.

   This course covers 358 hours of lectures, demonstrations, and practical training.
5. *Public Health Aspects of Civil Defence*—including a complete course in first-aid.
   (*a*) *Atomic Warfare Defence*

   Basic physics, defence principles, protection of personnel, food and water.
   (*b*) *Biological Warfare*

   An appreciation of the effectiveness and limitations of this weapon. Defence principles.
   (*c*) *Chemical Warfare*

   Types of chemical weapons, effects, protection.
   (*d*) *First-aid to the injured*
   (*e*) The general principles of disaster control from the public health standpoint.

Throughout the course we have endeavoured to combine theory and practice so that an approximately equal number of hours are devoted to each.

In January 1953, with the establishment of a permanent training centre by the Ontario Department of Health, the Canadian Public Health Association discontinued its correspondence course in this Province. Residents of Ontario may obtain training only by attendance at the course.

The students either are sponsored by local health agencies or have received an assurance of employment on qualification. The class average, on a basis of weekly tests, was from 75 to 80 per cent. This standing was a source of gratification to students and instructors alike. Most of our students are closer to twenty than thirty in age. While no definite age limits are laid down, the committee prefers students who are not less than 20 nor more than 35 years old.

Our students are not "supermen" from whom extraordinary standards of performance are to be expected. Their selection is based on schooling and personality, and they receive a training in sanitary science to meet certification requirements and the current demands of public health in Ontario. Further, we hope that our students are being prepared to profit by observation and experience, to look

at the public health program as a whole, to work with others, and to know where to obtain specific information.

Students may be awarded bursaries during training. These amount to $125 a month for single men and $175 for married men. If a student's wife is in receipt of taxable income, he is paid at the single rate. In all cases tuition is free, but the student must provide his own text-books, for which an initial outlay of at least $50 is required at the time of enrolment.

The Departmental Committee is giving thought to the establishment of refresher courses for graduate sanitary inspectors. Such courses, we believe—and in this the executive of the Canadian Institute of Sanitary Inspectors seems to concur—should be open to chief and senior inspectors in the first instance. These matters take time. The under-graduate course is the result of two years' investigation and study, and we expect to improve on it in the years to come. Similarly, refresher courses, of a nature to suit everyone and yield the optimum results in the general public health program, require thorough preparation.

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Epidemiology

SUCCESSFUL VACCINATION FOLLOWING SMALLPOX

AN attack of smallpox is generally considered to provide a life-long immunity. That there are exceptions is well known and the following well-authenticated case is of interest.

Mr. T. W., born in England in 1879, was vaccinated in infancy and developed a good scar, which was still visible in 1953.

In 1925, at the age of 46, he contracted smallpox in British Columbia, where a mild form of the disease was epidemic. He was cared for in the Vancouver City smallpox hospital and discharged after three weeks. This has been confirmed by local health department records.

On March 4, 1953, at the age of 74, he was re-vaccinated in Vancouver as a requisite for obtaining a traveller's vaccination certificate preparatory to making a trip back to England. The vaccine used was that prepared by the Connaught Medical Research Laboratories, Toronto.

When seen on March 11, 1953, he showed an accelerated reaction with an umbilicated pustule about 1 cm. in diameter at the site of vaccination. Little redness or swelling was present and there were no generalized symptoms.

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NEWS

Trial of Poliomyelitis Vaccine in the United States

A TOTAL OF 502,000 children in the United States have been inoculated in the nation-wide trial, sponsored by the National Foundation for Infantile Paralysis Inc., of the preventive poliomyelitis vaccine developed by Dr. Jonas E. Salk. Three additional States decided to participate in the program during the week of May 10th—Massachusetts, North Carolina, and North Dakota—making a total of forty-four States participating in the experiment. Neither Georgia nor Arizona has joined, because of an early incidence of poliomyelitis. The vaccine is not being given in areas where poliomyelitis is already prevalent.

Half the children in the trials are injected with the vaccine developed by Dr. Salk, while the others receive a neutral substance of similar appearance. A second injection is given after an interval of one week, and a third a month later.

According to Dr. Hart Van Riper, medical director of the National Foundation, the program has run exceptionally smoothly, although it involves hundreds of thousands of children. The co-operation of parents and teachers, and the willingness of the children, have resulted in a high degree of efficiency. If the results are to be evaluated correctly, it is imperative that the children receive the three injections. Field workers have reported that relatively few children have failed to report for the second injection. In New York City only 5.3 per cent did not return.

Miss Florence H. M. Emory to Retire

ONE OF CANADA'S best-known nurses, who has received international recognition, Miss Florence H. M. Emory, professor of nursing and associate director of the University of Toronto School of Nursing, with which she has been connected for thirty years, is retiring this year.

Throughout her career Miss Emory has been concerned with public health nursing practice and preparation. She served in staff and supervisory posts with the Department of Public Health, Toronto, from 1915 until 1924, when she joined the Department of Public Health Nursing at the University of Toronto as assistant director, to develop the certificate course in public health nursing for graduate nurses, combining theory and practice.

When the department became a school in 1933, she continued to be associated with Dr. Kathleen Russell in its direction, with administration of public health nursing courses and the teaching and principles of public health nursing as her major concern. She has maintained close association with this field and with the organized profession.

Miss Emory has received several honours for her work, the most recent being the Florence Nightingale Medal awarded last May by the International Red Cross, Geneva, "for outstanding contributions toward the development and prestige of the nursing profession." Miss Emory was the seventh nurse in Canada to receive the Medal since the awards were established in 1920. She has been president of the Canadian Nurses' Association, chairman of the public health nursing section of the Canadian Public Health Association, and chairman of the nursing advisory committee of the Toronto Branch of the Victorian Order of Nurses. In 1935 she was appointed chairman of the nursing committee of the Ontario Division, Canadian Red Cross Society, and remained in that office until 1951, when she became national chairman of nursing services. She is also well known in the international field, having been chairman of the membership committee of the International Council of Nurses from 1933 to 1953. She is the author of "Public Health Nursing in Canada", published in 1945 and issued in a revised edition last year.

Miss Emory hopes to retain active interest in the Victorian Order, the Red Cross, and other community interests. But she also has a new interest—an attractive bungalow in Leaside, with a garden, to which she is looking forward eagerly.

Quarantine Measures and Vaccination Requirements for Travellers

THE WORLD HEALTH ORGANIZATION has published a world-wide review of the quaran-

tine measures and vaccination-certificate requirements applying to travellers arriving in countries by land, sea and air. It is called "Quarantine Measures and Vaccination Certificate Requirements" and issued as supplement 1 to the Weekly Epidemiological Record No. 9, 1954.

The requirements concern chiefly cholera, yellow fever and smallpox, and health authorities may apply them to travellers under the International Sanitary Regulations. These regulations, adopted by the World Health Assembly and in force since October 1, 1952, govern international trade and travel.

Some countries—among them, Switzerland, Norway, Finland, and Austria—at present require no vaccination certificates from travellers, even those arriving from areas infected with the "quarantinable" diseases. It is expected that the number of such countries will grow as health services improve, since a community is more effectively protected against quarantinable diseases by a sound public health service than by a barrier of quarantine measures.

The WHO publication indicates the situation on March 5, 1954, and includes a statement showing whether countries and territories are party to the International Sanitary Regulations. One hundred and forty-three countries and territories are bound without reservation to these regulations. Eight are bound with reservations and thus may apply stricter measures than those prescribed in this international code in respect of the diseases to which the reservations apply. They are: Saudi Arabia, Ceylon, Greece, India, Pakistan, the Philippines, the Union of South Africa, and South West Africa. Thirty-six countries and territories are not at present bound by the regulations. For this there are several reasons. Some have rejected the regulations (it is hoped temporarily); some have still under consideration modifications, which were made by the World Health Assembly, to the reservations which they had submitted; others are awaiting the completion of a constitutional requirement. Countries and territories to which the regulations do not yet apply remain bound by pre-existing International Sanitary Conventions to which they were party and which the regulations were designed to replace.

Fluoridation Committee Formed by Health League

THE HEALTH LEAGUE OF CANADA has announced the formation of a committee of doctors, dentists, and laymen to study the merits of fluoridation of water supplies as a public health measure to prevent tooth decay in children.

From an educational standpoint, the committee will devote itself to insuring reliable and responsible presentation of the facts for and against fluoridation, by challenging inaccurate, misleading or irrelevant "statements" in the press and by keeping the pertinent issues before the public.

British Columbia

THE ANNUAL INSTITUTE for public health staff was held at the Hotel Georgia, Vancouver, from April 20th to 23rd. Among the 300 people attending were field staff from all health units in the Province and members of the Provincial Health Branch in Vancouver and Victoria. An annual event, the Institute is part of the in-service training program for public health workers. Heading the group of some fifteen speakers were Miss Ruth Gilbert, Assistant Professor of Nursing Education at Teachers College, Columbia University, whose series of talks were devoted to the role of prevention in mental health. A member of an advisory panel of nurses to the U.S. Public Health Service, Miss Gilbert is coordinator of one of the training programs under the Federal Mental Health Act. Subjects included in the intensive, four-day agenda were poliomyelitis, accident prevention, health teaching in the schools, and child development.

Of interest was the holding of the annual meeting of the British Columbia Branch of the Canadian Public Health Association at the time of the Institute. The organization of the Branch has been advanced through the leadership of senior members of the Provincial Department of Health and the Health Department of the City of Vancouver. Through the British Columbia Branch, public health personnel of the Province are enrolled as active members of the Canadian Public Health Association, which is the professional society of public health workers from coast to coast.

A NEW WING at the Simon Fraser Health Unit, New Westminster, was opened towards the end of March. Built with funds from Federal, Provincial, and municipal grants, the wing will provide increased accommodation for the public health staff and also for the New Westminster Stationary Clinic of the Division of Tuberculosis Control.

A NUMBER OF public health personnel from British Columbia are participating in the

meeting of the Western Branch of the American Public Health Association, to be held this month in Seattle. Among the participants are Dr. G. F. Amyot, Deputy Minister of Health; Dr. A. J. Nelson, Director, Division of Venereal Disease Control; Dr. G. R. F. Elliot, Assistant Provincial Health Officer; and Mr. J. H. Doughty, Director, Division of Vital Statistics.

Manitoba

DR. R. A. CHRISTIE, of Inverness, Scotland, has temporarily assumed the duties of medical director at the Red River Health Unit in Steinbach. A graduate of Aberdeen University, Dr. Christie was for a time house surgeon at the Royal Northern Infirmary at Inverness. Later he was in general practice in England.

DR. T. N. HURLEY, of Dublin, Ireland, will succeed Dr. John O'Keefe as medical director of the Stonewall Health Unit, at Stonewall. Dr. Hurley, who is a graduate of the Royal College of Surgeons, Dublin, has spent the last three years in Prince Edward Island as senior medical officer with the R.C.A.F. Dr. O'Keefe will head the Northern Health Unit at Flin Flon.

BY PROVINCIAL STATUTE the Greater Winnipeg Mosquito Abatement District was authorized in April to take over all mosquito control activity. The new plan will be financed by a tax levied on the citizens of the Greater Winnipeg area.

New Brunswick

JUST RECENTLY Dr. J. A. Melanson, Registrar General of Vital Statistics, had the Department of Health and Social Services inaugurate the short form or wallet size of birth certificate.

DURING THE LATTER PART of March, the Hon. J. F. McInerney, M.D., Minister of Health and Social Services, attended Federal-Provincial Civil Defence meetings in Ottawa and Arnprior, in company with Mr. J. A. Paterson, Provincial Co-ordinator.

THE PARENT-EDUCATION Committee of the Provincial Home and School Association, in collaboration with staff members of the Mental Health Division, has launched a program whereby representatives of various Home and School Associations in the Province meet at regular intervals for the discussion of specific mental health problems. These study groups are under the direction of trained personnel from the disciplines of clinical psychology and psychiatric social work.

JOHN NASH, Ph.D., of Edinburgh, Scotland, has joined the staff of the Mental Health Division, in the capacity of clinical psychologist.

DR. J. R. MAYERS, Director of Maternal and Child Health, reports that representatives of the Health Department and the Maternal and Child Health Committee of the New Brunswick Medical Society have met and conferred on a number of occasions during the past few months. It is appreciated that the reduction of the maternal mortality rate becomes mainly a problem of education, both of the medical and nursing professions and of the general public, and it was agreed that the best results will be obtained by detailed analysis of the causes of each maternal death. It is proposed that the Committee and the Health Department will collaborate in working out a standard and exhaustive enquiry form which will cover all clinical and social aspects of maternal deaths.

Nova Scotia

THE PROVINCIAL DEPARTMENT OF HEALTH has, since January 1 of this year, been providing field experience for five registered nurses who will attend university in the fall. They are: Misses Katherine Weir and Alvara Sim, Northumberland Division; Miss Mary Ann Pugsley, Atlantic Division; Miss Marie Louise Smith, Fundy Division; and Miss Marilyn Himmelman, Lunenburg-Queens Division.

TWENTY-SEVEN of the Provincial Public Health Nurses attended the Institute on Nursing Aspects in the Care of the Child, which was held at Dalhousie University on March 10, 11 and 12. The Institute was sponsored by the School of Nursing, Dalhousie University, of which Miss E. A. Electa MacLennan is director.

AT THE PRESENT TIME the Provincial Department has seven nurses taking public health at universities, as well as two senior nurses enrolled for advanced training at McGill University and the University of Michigan. It is hoped that many more nurses will take advantage of the Federal Health Grant bursaries to aid them in taking post-graduate work in public health nursing.